SEAFRAME

Summer 2005 • Volume 1 • Issue 1

Ships & Ship Systems Quarterly Publication

ENCAPSULATED PROPELLER

Innovative Process May Improve Performance and Save Money

LIGHTENING THE LOAD

Technology and Teaming Ease Shipboard Operational Logistics

USS VIRGINIA

The Science of Silence

PREMIERE EDITION

Report Documentation Page

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SEAFRAME
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Transforming Our Business for the Customers

S^3 Ships & Ship Systems NotePAD

By Charles (Randy) Reeves

Welcome to our inaugural issue of SEAFRAME—a publication that highlights the Navy's integrated efforts in supporting the fleet's ships and ship systems. The title "SEAFRAME" highlights our emphasis on functional assessment in systems engineering. With new ship concepts using modular payloads and being multi-mission capable, we focus on the sea frame and integration of payloads and combat systems to provide a total ship system.

We are nearly two years into the transformation of NAVSEA and its Warfare Centers from a collection of individual organizations, vying for work, into a nationally focused set of product areas aimed at doing the right work, in the right place, at the right time. One of 12 product areas, the Ships and Ship Systems (S^3) Product Area encompasses all platforms, systems, and components essential for the operation, mobility, and survivability of surface ships, submarines, boats and craft, and unmanned vehicles. It also includes systems and expertise essential for the platform, combat, and weapon systems integration. S^3 is comprised of seven core equity areas that cross all Navy mission and warfare areas and support *Sea Power 21*.

Established in October 2003, the S^3 Product Area has aligned its business approach to that of the Naval Sea Systems Command. Essential to any business, our Strategic Plan was released in July 2004. Discussed in an article on page 2, this plan, which will be updated in September, sets the pace for the S^3 efforts. Working with the Warfare Center Board of Directors (WCBoD), we have coordinated our planning with the WCBoD integrated planning process, which lays out an annual cycle. Integral to this process is the technical health assessment, a foundational process that maps the core equities to the technical capabilities to the knowledge areas. We will use it in multiple areas including strategic planning, business planning, and human capital strategy. Each product area director is responsible for accepting all work and assigning it to the appropriate Division or the "best athlete." To accomplish this, the warfare centers set up common processes and a web-based work assignment database (WAW). We have successfully implemented the data from'04; we are now working on '05 data and refining the process.

Probably the most significant change in the way we do business has been the addition of a virtual organization of customer advocates. Established to represent our customers' best interests, these advocates focus on customer interface and customer satisfaction. An article on our customer advocates appears on page 3. A concept of operations for these customer advocates was signed with Carderock Division in April 2005 and will be expanded to include the other Divisions supporting S^3. Finally, as part of the rollout of Task Force Lean at NAVSEA, each product area director is overseeing Lean implementation in his/her area. Working closely with Task Force Lean, champions have been designated, and Lean implementation is accelerating. I have high hopes for what we can achieve through this process improvement effort.

The strategic plan, the customer advocates, the technical health assessment, and indeed, this publication all reflect our national focus on the S^3 Product Area. If you'd like to read more about the S^3 Product Area and its business products, log onto **www.nswcdc.navy.mil/S3.** We are dedicated to ensuring full understanding of this new way of doing business.

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Cover design by Gloria Patterson

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S3 BUSINESS

The SHAPE of THINGS to COME

Planning the Way for Ships and Ship Systems

By Arnold Ostroff

With the alignment of the Warfare Centers and establishment of the product area directors (PADs) in 2003, many of the basic functions of strategic planning shifted from the Warfare Center Divisions to the PADs. Each PAD is now required to develop strategic objectives, annual business plans, and long-range planning for investments.

In July 2004, the Ships and Ship Systems (S^3) Product Area developed its inaugural strategic plan. That plan put forward six strategic goals (see box), which are crucial to advancing the product area and the Navy's *Sea Power 21* vision.

Objectives were developed for each of the strategic goals, and elements of the strategic plan were used this year to evaluate investment proposals. However, the environment is changing; and now, one year later, the strategic plan must be reexamined to ensure that it still provides the best description of how the product area will support the Navy's long-term needs. For that reason, we are embarking on a comprehensive process that will not only reassess the strategic plan but also improve its alignment to higher-level planning, customer plans and requirements, and future investment needs.

An updated strategic plan will be issued this fall. Supporting its development will be an environmental assessment and a business forecast. These efforts will provide a better understanding of how changing external factors, customer needs, and workload requirements could impact the product area. After the strategic plan is completed, a tactical plan will be prepared to translate the strategic goals into annual planning guidance and resource needs. Finally, action plans for each of the objectives will be developed and monitored on a quarterly basis.

This new planning process will also be coordinated with Warfare Center and Division planning efforts to ensure synchronization of planning events and the best use of common information.

SIX STRATEGIC GOALS

1. **High speed and maneuverable ships.**
2. **Ships and ship systems that improve warfighting performance through optimized manning.**
3. **Advanced electrical technologies that enable the transition to all-electric ships.**
4. **Ships and ship systems that provide improved payload capability and rapid in-theater changeout.**
5. **Enhanced survivability of ships and ship systems through advanced low observability technologies, damage tolerant designs, and automated system reconfigurability.**
6. **Highly sustainable and logistically supported ships and ship systems that enable Seabasing.**

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CUSTOMER ADVOCACY

CUSTOMER ADVOCATES Provide Bridge to S^3 Product Area

By Leslie Spaulding

Obtaining comprehensive customer support will be easier for the Navy Warfare Center customer in the area of ships and ship systems. By mutual agreement with Carderock Division, the Ships and Ship Systems (S^3) Product Area established a virtual organization of customer advocates to serve as functional agents of the product area directors (PADs), in an additional duty capacity. Their role is to interface with customers to develop a unified customer support approach that brings together efficient and effective combinations of technical capabilities that span multiple divisions. They are responsible for the management of relationships with the Warfare Center customers.

Before retiring as Commander, Naval Sea Systems Command, Vice Admiral Phillip Balisle stressed the importance of customer advocacy to all NAVSEA commands. Through customer advocacy, both NAVSEA and the Warfare Centers can operate as a seamless entity without encroachment or redundancy. As a result, the focus of product area management can shift from site level to a national level. Additionally, the resulting disciplined approach to work assignment and improved business processes promotes efficiency.

Applied throughout the NAVSEA corporation for the S^3 Product Area, this approach provides one voice to the customer, with each customer advocate overseeing all aspects of customer relationship management and customer satisfaction. These advocates serve to fully understand customer needs and work with the organizations supporting ships and ship systems to ensure those needs are met with the best value solution. Part of that support involves providing programmatic assessment and risk management for the customer, as well as providing services to customers by recommending appropriate make/buy decisions for products and services. The advocates work closely with the customer and the line

CAs Provide Bridge (Continued on page 5)

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CUSTOMER ADVOCACY

SUBMARINE CUSTOMER ADVOCATE

The Go-Between Organization

Interfacing with Technical Managers and Customers

By William Palmer

Customer advocates serve as functional agents of the product area directors (PADs). Their role in support of the PADs is to interface with customers to develop unified customer support approaches that bring together efficient and effective combinations of technical capabilities that span multiple Divisions. They are responsible for the management of relationships with the Program Executive Officer (PEO) or Warfare Center customers. In addition, they work with the PAD on work acceptance and assignment, as well as synergy and teaming.

One such advocate is Larry Tarasek, the lead Submarine Customer Advocate for the Ships and Ship Systems (S^3) Product Area. The intent of the Submarine Customer Advocacy Group is to make the connection between the submarine customers and the organizations that do the work for them. Major submarine customers include the Program Executive Office, Submarines; the Undersea Warfare Directorate; the Undersea Technology Group; and the Submarine Design and Engineer Group. The tasks for these customers are accomplished by any group which can perform the right work, in the right place, at the right time. Usually, the work engages the technical abilities of the Carderock Division but can extend to any of the Warfare Center Divisions that satisfy the customer's requirements for S^3 products.

Tarasek's main objective is to have the submarine customer advocates serve as the primary interface between the customer and Warfare Center line organizations. A second objective is to oversee all aspects of customer relationship management and satisfaction. Third, these advocates must understand customer needs and advocate on behalf of the customer within the Warfare Center. "I view those top three as very important to what we do as customer advocates for submarines," says Tarasek. "The other key ingredient is, of course, to work with line managers to ensure that cost, schedule, and performance are properly constructed, assigned, and supported. The customer advocates enable customers to make one phone call to get actions addressed.

CAs Provide Bridge (Continued from page 3)

managers within the Warfare Center to ensure their requirements, tasking, deliverables, work schedules, and funding are properly constructed, assigned, and supported.

Customer advocacy within the NAVSEA enterprise is an extension of the PAD concept. The customer advocates are functional agents of these PADs. With customer advocates, the PADs can execute their responsibility to maintain discipline in the Warfare Centers' work acceptance and assignment process, eliminating unwarranted duplication of work among its various organizations. The actual execution and management of the work is still done within the various organizations; however, the customer advocates provide a bridge between the customer and the engineer or technologist, providing both effectiveness and efficiency in the process.

Within the S^3 Product Area, the customer advocacy organization is comprised of an overall lead for customer advocacy and leads for each of the six groups: Submarines, Carriers (Future and In-Service), Ships, Joint Programs, NAVSEA/Multi-Platforms, and Science and Technology. Each lead advocate is supported by a team dedicated to the execution of the right work, in the right place, at the right time for the customer.

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Trident (*Ohio* Class) Submarine.
U.S. Navy Photo

SHIP INTEGRATION & DESIGN

CROSS-PRODUCT AREA COLLABORATION

Special Operations Community of Interest

By William Palmer

Engineers working in the Ships and Ship Systems (S^3) Product Area are collaborating with engineers from several other product areas. A "community of interest" (CoI) addresses the mission-related needs of the Special Operations community. Warfare Center personnel, in alignment with seven of the 12 Warfare Center product areas, are currently working closely with the Special Operations community to lay the groundwork for a smooth and efficient way of addressing those customers' mission requirements. Vision, goals, and a mission charter are currently under development.

An initial meeting in November 2003 included the S^3 and Littoral Warfare Systems Product Areas, as well as several Warfare Center PAD representatives on site at U.S. Special Operations Command (USSOCOM). Motivated by a basic desire to meld the various groups together with those personnel who were aware of what work other sites were performing, the initial meeting aimed to determine what possibilities exist for collaboration.

Much of the value of this collaborative effort comes from dialogue during meetings to discover capabilities and technologies across the whole group that can be leveraged to assist USSOCOM. The initial focus was to determine how the Warfare Centers could best help develop craft and other technologies or capabilities to better meet the needs of the warfighter. The effort grew from that initial meeting, and now the product area representatives are becoming more total warfare system oriented instead of being site oriented.

Special Operations
MK V.
Photo By John Garrett

Special Operations MK V.
Combatant Craft, Carderock Division

In June, the product areas pooled resources to field an exhibit booth at USSOCOM's Advanced Planning Brief to Industry. The exhibit highlighted the collaborative response by the product areas to USSOCOM's mission requirements.

The overall purpose of the Special Operations CoI is to provide technical and strategic leadership across the Warfare Center for developing, applying, and fielding systems for the Special Operations Forces. The CoI also fosters a spirit of cooperation, communication, collaboration, and shared vision that ensures that the full capabilities of the Warfare Center enterprise are leveraged to the maximum extent possible.

This Warfare Center team has comprehensive understanding of the unique requirements of the USSOCOM and is therefore able to develop and maintain a robust portfolio of knowledge areas, capabilities, and facilities.

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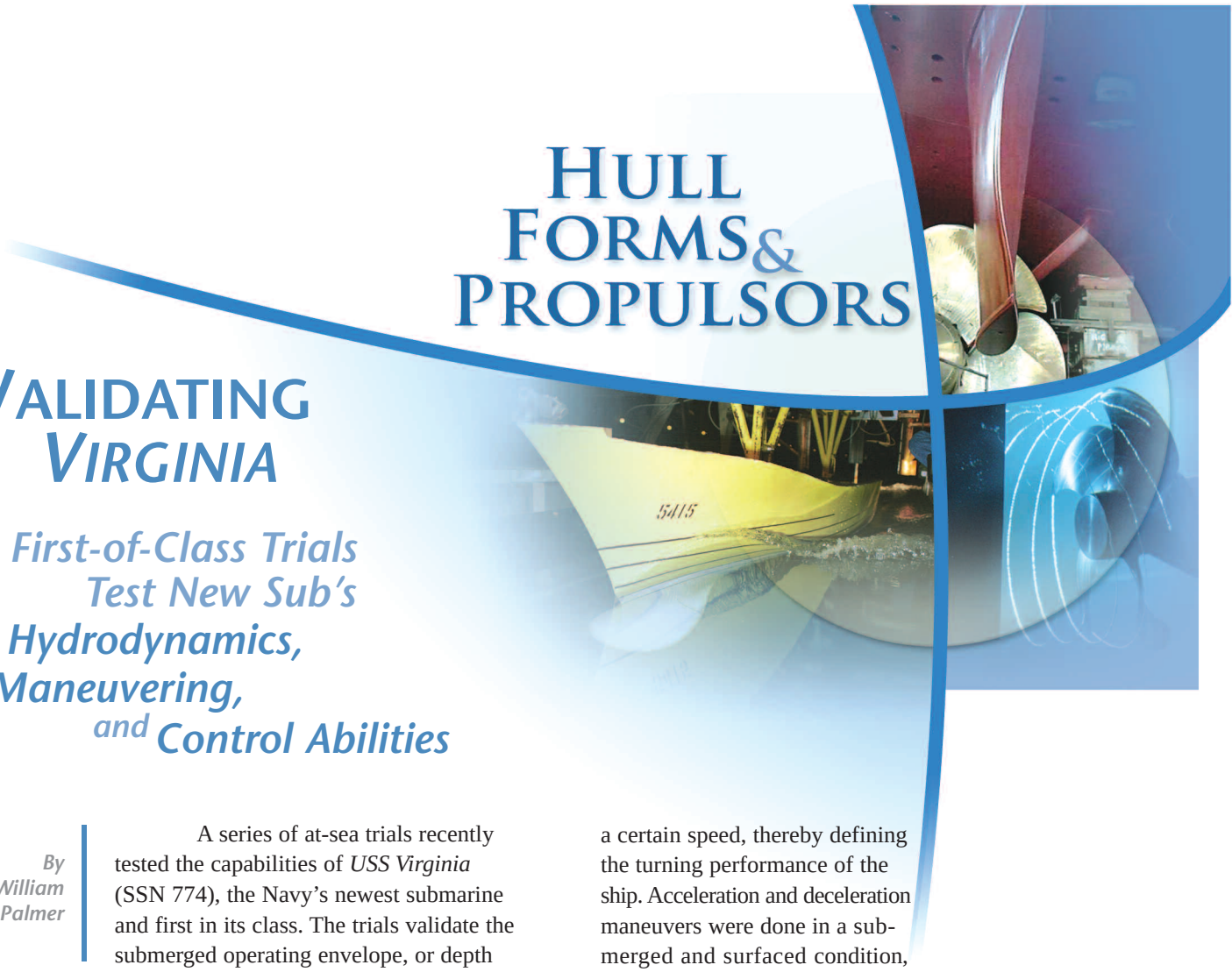

HULL FORMS & PROPULSORS

VALIDATING *VIRGINIA*

First-of-Class Trials Test New Sub's Hydrodynamics, Maneuvering, and Control Abilities

By William Palmer

A series of at-sea trials recently tested the capabilities of *USS Virginia* (SSN 774), the Navy's newest submarine and first in its class. The trials validate the submerged operating envelope, or depth and speed parameters within which the submarine must stay to ensure recovery in the event of a control surface casualty provided proper recovery actions are executed, as well as validate other guidance and performance characteristics critical to successful operation of the ship.

The first trial, held in November 2004, began the set of 3- to 4-day-long trials exclusively devoted to validating the boat's operating parameters and the ship's response to various casualty conditions. The trials also looked at how the ship responded to manipulating the control surfaces. The results of these trials were used to adjust the operational guidance, making it more representative of the actual performance of the ship.

A follow-on trial in February 2005 was much more of a characterization of the ship performance, establishing such data points as speed-vs.-propulsor rpm, torque, and horsepower. Maneuvering exercises were also conducted, further characterizing the boat's turning performance submerged and surfaced. One aspect that test engineers aimed to measure was how much distance the ship would take to turn in a certain direction going at a certain speed, thereby defining the turning performance of the ship. Acceleration and deceleration maneuvers were done in a submerged and surfaced condition, and these maneuvers helped show how fast the ship could answer an engine bell and how quickly the ship could slow down from a certain cruise speed.

Much of the information gathered from these trials will be directed to engineers and scientists to validate and refine, if necessary, a ship control simulation of the *Virginia*, the engineering of which is being done by the Ships and Ship Systems (S^3) Product Area. Researchers essentially viewed these maneuvers as validations of their simulation, giving them feedback on how accurate the simulation is. The feedback is valuable, as it helps refine the program, making it more relevant to future submarines of the same class, as well as future sub classes and future modifications to the *Virginia*. So far, performance predictions have been very close to actual performance, thanks in part to input from *Seawolf* and *Los Angeles* Class performance data.

To provide further real-world data for the simulation, control surface effectiveness exercises were also included in the boat's trial schedule. Answers were sought to questions such as, what is the effect of using

USS Virginia (SSN 774). *Photo by General Dynamics Electric Boat*

only stern planes to maneuver the ship in the vertical plane. Trials with a simple agenda, such as changing control surface angles (such as bow planes, stern planes, and rudder) and observing the ship's response were conducted. Engineers also sought to understand whether the ship would pitch up, pitch down, or go through a turn level with the rudder being deflected and all other control surfaces neutral.

Other trials tested the ship's emergency recovery performance using the *Virginia*'s split stern planes. The stern planes are actually constructed as two pairs of separate control surfaces, two inner and two outer control surfaces with each pair individually controlled by the ship control system. Separate hydraulic control systems move the inner and outer surfaces in unison or independently. If one pair of stern planes is jammed in an extreme position, this feature allows the use of the other pair of stern planes to counter the effects of the jam.

Software for the *Virginia* fly-by-wire control system contained the "split stern planes mode," whereby control of the inner stern planes can be assigned to one joystick, and control of the outer stern planes can be assigned to the other joystick. This permits much more realistic control situations for simulating a stern plane jam for emergency recovery trials or for crew training.

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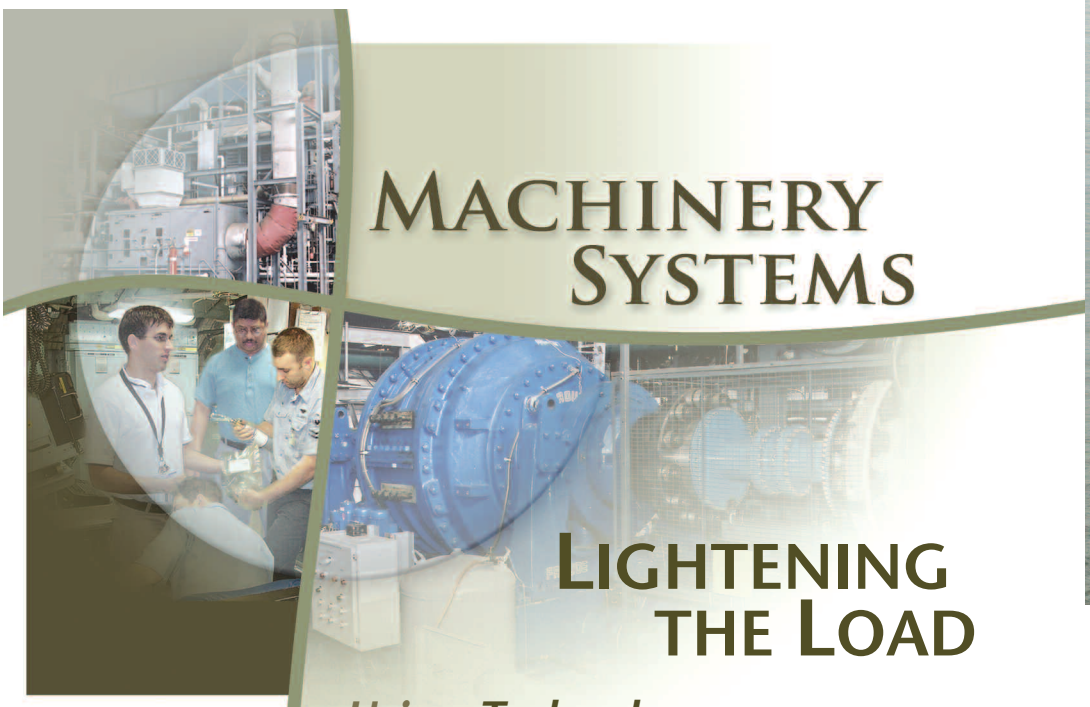

MACHINERY SYSTEMS

LIGHTENING THE LOAD

Using Technology and Teaming to Automate Shipboard Operational Logistics

Skin-to-skin transfer between ***SS Cornhusker State*** (T-ACS 6).

By Stephen Michetti

The Warfare Center Material Handling and Transfer (MHAT) team, established in FY00 to promote collaboration and integration of Operational Logistics (OpLog) system programs and initiatives, includes representatives from Philadelphia, Carderock, Port Hueneme, Panama City, and Indian Head. MHAT-related efforts are primarily under the cognizance of the Ships and Ship Systems (S^3) Product Area but also impact Littoral Warfare, Logistics and Maintenance, and Ordnance Product Areas. Members interface with the fleet, technical warrant holders, ship design/acquisition program managers, ONR and industry, and support OpLog Integration Program, Seabase Logistics CONOPS, and related initiatives.

The term "operational logistics" describes the management and movement of material from factory to end user for naval operations. Many shipboard OpLog systems (e.g., fork trucks, elevators, connected replenishment, etc.) have been used for more than 50 years. They perform their intended mission utilizing extensive time, manpower, and process workarounds, such as material pre-staging. The result is an unbalanced system. Improvements in safety, operation, and reliability of systems have been made, but transformational change is necessary to balance the system and meet future challenges. Ship acquisition programs and warfighting concepts, such as Seabasing, will require increased throughput, flexibility, and reduced manning.

The goal is to respond to warfighter needs with a shipboard automated warehouse with an automated inventory management system which locates commodities using radio frequency identification (RFID) technology, selectively delivers items to an autonomous vertical/horizontal transport system, and transfers the load for delivery to the end user. But how realistic and affordable are low maintenance, user-friendly shipboard applications of such systems? The ultimate answer will be determined as technology evolves, but the Warfare Center is heavily involved in the process as we move forward.

Programmable logic controllers being installed on material handling systems enable network connectivity and provide interface for inventory management, prognostic maintenance, and distance support. Shipboard demonstration of RFID technology will be conducted this year to assess total asset visibility systems. Joint Modular Intermodal Container engineering design models are being evaluated for optimization of prototype containers that will standardize packaging, reduce waste dunnage, and optimize handling. Laser sensors replacing costly,

SS Flickertail State (T-ACS 5) and
U.S. Navy Photo

maintenance-intensive elevator trunk proximity and limit switches are being evaluated to prepare for FY06 shipboard demonstration. Preliminary shipboard testing was conducted on a simulated integrated landing platform, a self-deploying floating platform used for ship to LCAC/lighterage interface. Shipboard demonstrations were also conducted to evaluate effectiveness of a shipboard crane pendulation control system used to stabilize loads for safe handling and to demonstrate the feasibility of skin-to-skin operations. The next generation underway replenishment "Heavy Unrep" system is being developed to increase throughput and improve safety. The Navy's Unrep site has a new receiving structure to test the Unrep Sliding Padeye later this year. Interface with new ship acquisition programs is accomplished to ensure interoperability. Early involvement in Seabasing has included technical paper presentations and the hosting of workshops.

The Warfare Center's role in developing and assessing technology of these and other initiatives will contribute to significantly improved shipboard operational logistics systems that will enable the warfighter to better meet future challenges.

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ENHANCED MAINTENANCE

Wireless ICAS Goes Live

By Walt Kostyk

The next time you open a newspaper or turn on the television, you'll encounter numerous advertisements for wireless networking products, such as routers, cards, portable devices, and application software. Similarly, chances are good that the last hotel, airport, or college campus you visited was wireless-enabled. You may even have set up a wireless local area network (WLAN) in your own home. Wireless technologies are quickly proliferating into mainstream society. What you may not know is that the same thing is about to happen in the fleet.

Engineers within the Ships and Ship Systems (S^3) Product Area are prime movers behind this evolution. Over the last three years, they focused on developing and testing wireless applications and products that enhance the condition-based maintenance (CBM) capabilities of the Integrated Condition Assessment System (ICAS). Their efforts produced a wireless ICAS subsystem, known as the Wireless Enhancement of ICAS (WEI). This subsystem reduces the cost of data acquisition and empowers ships' crews to reduce their maintenance burden. In late March 2005, the Navy achieved a significant milestone in this area when ICAS and the WEI subsystem were permanently activated aboard Ex-*USS Paul F. Foster* (EDD 964).

The ICAS/WEI installation aboard the ship is an example of Warfare Center divisions sharing resources to achieve individual and mutual objectives. That installation will enable ship's force to conserve resources

Wireless ICAS (Continued on page 12)

Wireless ICAS (Continued from page 11)

by automating shipboard maintenance processes and preventing/diagnosing equipment failures.

This effort supports multiple core equities within the S^3 and Surface Combat Systems Product Areas. The *Foster* platform is a perfect setting for evaluating new designs and testing integrated solutions across the Warfare Center enterprise. Already, there is interest in testing wireless calibration and advanced pressure sensors aboard Ex-*USS Foster*. Additionally, Distance Support solutions utilizing data and video acquired by the ICAS/WEI suite will be developed to support the Surface Warfare Logistics and Maintenance Product Area. The platform will also be used to test ICAS hardware and software initiatives under the Products Approved for Shipboard Services (PASS) process. Testing aboard Ex-*USS Foster* will help evolve ICAS to meet the ever-evolving CBM needs of the fleet.

The core ICAS network aboard Ex-*USS Foster* consists of three network switches redundantly connected via fiber-optic cable in Gigabit Ethernet and four ICAS computers. A wired interface provides online ICAS access to propulsion and electrical plant signals. The wireless network is made up of 18 WLAN access points, 27 network-capable application processors, and two wireless laptops. The application processors are permanently mounted devices that collect online analog signal information from the high-pressure air compressors, low-pressure air compressors, and one air conditioning plant. They also process wireless video from 12 fixed and pan/tilt/zoom cameras for safety and situational awareness purposes. The two wireless laptops are view ports for live video and ICAS data, which can be utilized anywhere on the ship where there is wireless coverage. All wireless communications are encrypted with a FIPS 140-2 Level II-certified solution.

Additional wireless initiatives are currently being planned. For Ex-*USS Foster*, the remaining air conditioning plant will be instrumented in October/November 2005. Integration with selected combat systems and combat support systems will take place within this window, as will linkage to the ship's existing point-to-point communication system. Installation of a WEI suite aboard

Ex-*USS Paul F. Foster.*
U.S. Navy Photo

the X-Craft is taking place this summer. In addition to the wireless suite, this includes an enhanced ICAS graphical user interface designed to support unmanned engineering spaces. Installation of WEI variants is also envisioned for the Trident Warrior-05 exercise and the evolving remote monitoring experiment.

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An Evolution of Corrosion Control

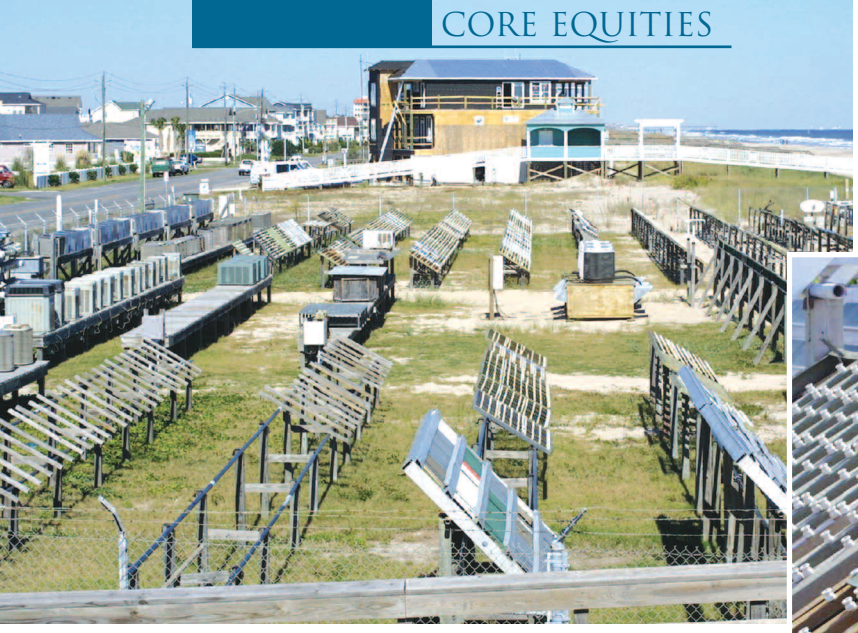
Researchers Home in on Ways to Fight Corrosion

By William Palmer

Corrosion is one of the Navy's biggest maintenance costs, and a 2002 study by the National Association of Corrosion Engineers supports that claim: DoD spends around $20 billion every year in combating corrosion alone. The Navy puts a lot of steel into the salt-water oceans of the world, and that's an extremely harsh environment from a corrosion perspective, impacting safety, readiness of our fleet components, and the cost of keeping components ready to fight. In the Ships and Ship Systems (S^3) Product Area, corrosion control work ranges from basic 6.1 research to corrosion engineering and acting as in-service

Fighting Corrison (Continued on page 14)

STRUCTURES & MATERIALS



Overall view of the near-ocean test lot and of ongoing marine atmospheric exposure tests (close-up) being conducted at the LaQue Center for Corrosion Technology Kure Beach Marine Atmospheric Test Facility.
Photos by Andrew Sheetz

Fighting Corrosion (Continued from page 13)

engineering agents to fleet assets. Corrosion engineers are actively involved in making an impact on such fleet-focused tasks as reducing time in a dry-docking period or helping alleviate intense manual labor by Sailors in the fleet in conducting corrosion control onboard ship.

Coatings are the Navy's primary weapon in the fight against corrosion. Various organizations within the S^3 product area's Structures and Materials core equity are working to identify requirements for coatings and how they should perform. Their role is assisting NAVSEA to develop performance-based requirements, develop qualification test protocols, and modify documentation to enable fleet implementation of new coating systems and processes. All manner of aspects are being studied, from maintenance and removal to surface preparation techniques, coating life prediction, and maintenance processes associated with the coatings.

Another aspect the group is studying revolves around how the coatings will be used. A coating applied to the underwater portion of a ship's hull has to both provide corrosion protection and resist fouling due to marine plant and animal growth. The coating applied to a deck, by comparison, has to provide the same corrosion protection, but also has to be resistant to ultraviolet radiation and have acceptable non-skid properties. Then there's the application of coating a seawater ballast tank, which has to resist corrosion associated with fill and drain evolutions. Rather than formulate one coating to resolve a myriad of corrosion and preservation considerations, which is not possible at present, coatings are formulated to address separate issues.

Environmental impact is another area of concern for marine coatings. New environmental controls add to the load with which coating formulators must deal. Coating manufacturers are increasingly required to reduce the volatile organic compound (VOC), hazardous air pollutant (HAP), and heavy metal content of their coatings to prevent harmful release of these substances into the environment. Formulators are engaged in a tug of war as they deal with more stringent environmental requirements for the coatings and for increasing performance properties ship designers need.

Corrosion engineering also plays into a ship's design, with the need to use new materials to embrace positive design benefits balanced against possible negative impacts on existing hardware. Such activities as material selection, design for corrosion control, alloy characterization, and fleet problem solving help engineers mitigate down-time and asset degradation due to corrosion.

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Environmental Quality Systems

Environmental Engineering Enables Fleet

Improving Operational Mission Readiness

By Mary Jo Bieberich, Reprinted, in part, from Spring 2005 Currents Magazine

The Chief of Naval Operation's (CNO's) Operational Environmental Readiness Mission is the catalyst behind the research, development, and testing of environmental technologies conducted by the Navy. Direction is provided by CNO's Afloat/Shore Environmental Systems Integration Branch (N452) and the Navy's Central Technical Authority (CTA) for Environmental Engineering (NAVSEA 05M4). The Ships and Ship Systems (S^3) Product Area develops and assesses technologies that support and sustain core processes and capabilities integral to fleet operation and training. This includes providing the technological solutions that ensure Navy ships and submarines are designed and upgraded and can be operated worldwide affordably and in compliance with all applicable environmental laws and regulations.

For many years, the Navy's Environmental Program was executed with a focus on fleet modernization and government-centric acquisition processes. However, changes in national defense policy, more stringent environmental regulations, and environmental budget adjustments have shifted the focus of the program to fleet recapitalization strategies and ship design processes embedded in acquisition reform.

The NAVSEA technical warrant holder for environmental systems is transforming the business practices of the Environmental Engineering Program and providing the tools needed for sustained operations and operational readiness in the legacy and future fleets. Among these tools are American Bureau of Shipping (ABS) Naval Vessel Rules (NVRs) for environmental systems developed for NAVSEA. NVRs will support the design and acquisition of naval combatant ships and crafts by providing the technical basis and authorization for Navy and ABS certification of selected ship systems. To supplement the NVRs for environmental systems, NAVSEA is drafting design guidance for ship design agents, as well as updating the system performance specifications, standards, and technical data that govern shipboard environmental systems.

Mission Readiness (Continued on page 17)

VULNERABILITY & SURVIVABILITY SYSTEMS

DYNAMIC SHOCK TESTING

Shock Tests for Semi-Active Cabinet Isolation System Conducted

By Rebecca Buxton

A team of engineers recently performed shock testing of Enidine's Intelligent Shock Mitigation and Isolation System (ISMIS) at Dynamic Testing, Inc. (DTI), in Rustburg, VA. The team conducted the six-shot barge test series to determine whether the ISMIS devices, integrated with a passive lateral isolation system, would effectively protect electronic equipment housed in a cabinet during a shock event at sea. Generally, test results showed that the system was successful in protecting equipment in the vertical axis, but the lateral isolation system requires further testing before acceptable response to a shock event is realized.

To simulate a typical shock environment seen on a surface combatant, the equipment (including a standard computer, flat panel display, keyboard, and uninterruptible power supply) was installed in Automated Digital Network System (ADNS) equipment racks. The ISMIS devices and the lateral isolation system bridge the inner rack and the outer cabinet structure. The outer cabinet was base-mounted to a frequency-adjustable steel platform, known as the deck simulator fixture (DSF). The DSF is fixed to the testing barge, the floating shock platform (FSP).

To replicate a shock event, the barge was towed to the center of the pond and subjected to a series of underwater explosions using 60-pound HBX-1 charges at varying horizontal ranges. The first shot represented a half-energy attack, while the rest were executed at the more severe, full-energy standoff distance. Dynamic instrumentation including accelerometers, velocity meters, and displacement gages were utilized to measure the shock inputs and responses of the FSP, DSF, and isolated cabinet.

The ISMIS isolators themselves combine a bifurcated coil spring in parallel with a fluid spring, configured with a semi-actively controlled valve. To achieve the most effective mitigation of underwater shock inputs, this valve can be opened to soften the fluid spring or closed to stiffen it. The term "semi-active" indicates that the control system can only remove energy from the system and cannot add energy to it, thus enhancing its stability.

The lateral aspect of the integrated isolation system consisted of 16 passive wire rope isolators (four per vertical side) dovetail mounted on vertical sliders. The low-friction slides act to decouple the vertical and lateral motions, allowing

Underwater explosion shock test of ISMIS installed on a floating shock platform.

UERD Photo

Shock Tests (Continued from page 16)

the ISMIS devices and the wire rope lateral stabilizers to act independently.

Over the five full-energy shots, many parameters were varied for comparison. The cabinet was oriented both front-facing the charge and side-facing the charge. For each cabinet rotation the DSF was tuned to both 14-16 Hz and 25 Hz to simulate two different frequency environments. Also, one test was conducted with the ISMIS devices powered off eliminating the effects of the semi-active control.

From the measured test results, a number of technical conclusions were reached. First of all, the overall survivability was not greatly reduced by testing the ISMIS devices in a passive state; however, there were noticeable differences in the character of the responses since the energy is absorbed more efficiently by the active ISMIS isolator. Rotating the cabinet, while having the expected effects of switching the forward/aft and side-to-side responses, had little effect on the overall vertical responses of the inner, isolated rack. Changing DSF frequency demonstrated that the higher frequency environment results in a decrease in damage potential imparted to the isolated equipment. The higher frequency generates motions that follow the rigid body motions of the FSP while the DSF oscillations dominate the equipment responses in the lower frequency case.

Overall, the ISMIS devices performed very well creating vertical response environments considered benign and acceptable for the survival of a shock event. The lateral isolation system, however, degraded over the series of tests, producing unacceptable results in the lateral directions. Enidine, in conjunction with the Navy team, is currently considering developing options for improved lateral isolation. These include small High Energy Rope Mounts (HERMs), high frequency lateral isolation using Double Isolation Material (DIM) or Sorbothane, and simple hard mounting. Tests with the vertical ISMIS device and one or more new lateral isolation devices are scheduled for summer 2005. Pending successful test completion, ISMIS cabinets will potentially be included in a planned full ship-shock trial and eventually incorporated into the fleet.

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Mission Readiness (Continued from page 15)

Today, research emphasis is shifting from in-house technology development to surveying the industrial base and assessing commercial off-the-shelf (COTS) technologies that will support Navy needs now and in the future at reduced life-cycle cost. This new role consists of applying its expertise in ship systems and systems integration to assessing trends in environmental technologies at emerging and commercial stages, assessing the affordability and suitability of potential shipboard environmental solutions, selecting appropriate technologies for shipboard implementation, and conducting performance tests and evaluations.

This resulting body of knowledge, combined with extensive experience in ship integration and installation requirements, is providing valuable support to the technical authority in assessing the viability of commercial systems and equipment to meet cross-platform environmental requirements for the Navy's recapitalization process and the future fleet. The assessment of COTS systems requires an understanding of operational scenarios and the unique requirements of Navy ships. COTS environmental quality solutions intended for shore applications and commercial marine vessels are not driven by space, weight, shock, vibration, electromagnetic interference, ship motion, or the average operator skill level found on U.S. Navy ships.

The environmental engineering organizations at NAVSEA and the Warfare Centers refocused their engineering support responsibilities and human resources to better address operational mission readiness and environmental stewardship and to reduce current program costs. This focus included establishing the central technical authority for ship environmental engineering to provide program leadership, adopting the Navy's strategic vision for fleet recapitalization and new ship design, and assessing the industrial base for waste management technologies suitable for shipboard implementation. These actions are in concert with the Navy's national defense mission, environmental readiness goals, and business improvement initiatives and will enable the Navy to comply with environmental requirements now and in the future.

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Signatures, Silencing Systems, & Susceptibility

The Science of Silence

Experts Explore Underwater Signatures of USS *Virginia*

By Paul Luehr, Joyce Rogalski, Dr. Jan Niemiec, and William Palmer

Since the 1950s, engineers within the Ships and Ship Systems (S^3) Product Area have played a role in submarine silencing. This involvement in ship design for the earlier classes of submarines was mainly driven by the development of ship alterations (SHIPALTs) and provided individual silencing items for incorporation into the fleet, as well as acting as a stealth consultant to Naval Sea Systems Command (NAVSEA) and their contracted design agents. With the development of the *Los Angeles* (SSN 688) and *Ohio* (SSBN 726) Classes, and to a much greater extent, the *Seawolf* (SSN 21) and *Virginia* (SSN 774) Classes, this organization became more involved in submarine design and quieting processes. This proactive approach narrowed the gap between the R&D community and the ship construction community, primarily General Dynamics Electric Boat Corporation (GDEB) and Northrop Grumman Newport News (NGNNS), providing the Navy with fleet operational readiness through utilizing cost-effective acoustic and non-acoustic silencing technologies.

To better realize the benefits of this cost-effective business approach, two significant acoustic teaming processes were formed. First, the Naval Maritime Acoustics Consortium (NMAC) stood up to ensure that acoustic testing services of the primary member organizations would be provided to the NAVSEA customers in an efficient and cost-effective manner. The NMAC provides a cooperative relationship so that the members can share resources to deliver timely and high-quality test and evaluation (T&E) products and services to NAVSEA customers involved in full-scale acoustic testing.

Secondly, the PMS450 Acoustical Trials Working Group (ATWG) stood up. The PMS450 ATWG was established as an advisory board to provide technical and programmatic guidance to the *Virginia* Class T&E Manager (PMS450C2) in the successful planning and execution of acoustic testing on *Virginia* Class submarines. The ATWG provides a forum for discussing acoustic issues and requirements pertinent to the SSN 774 Class to assist the T&E manager in ensuring that acoustical trial evaluations address appropriate issues and requirements. Tangible benefits of this process ensure that fully integrated test teams will be utilized for both the Builder's Underway Noise Survey (BUNS) and NAVSEA acoustical tests, that an integrated common test agenda will be used for both efforts, that a common data acquisition system will be used, and that all parties will honor the work product commitments that drive the deliverables of either party.

The recent completion of the *USS Virginia* BUNS provided "real-world" proof that the months of demanding and complex planning efforts completed by the members of the PMS450 ATWG resulted in unprecedented acoustic test efficiencies. This effort encompassed nominally eight days of at-sea testing with *USNS Hayes* (T-AG 195), a mobile quiet research vessel instrumented with technologically complex equipment and used to accurately measure the acoustic signature of U.S. Navy submarines. In addition, the SSN 774 was equipped with an onboard data acquisition system. This system, the Acoustical Trial Onboard Measurement System (ATOMS), was interfaced with the Total Ship Monitoring System (TSMS) and successfully collected all required structureborne and platform/sonar self-noise data. Knowledge gained and lessons learned from the BUNS experience, as well as that of the recently completed *USS Jimmy Carter* (SSN 23) acoustic testing, is being aggressively integrated into the test execution plan for the upcoming SSN 774 Pre-PSA (Post Shakedown Availability) acoustic test.

Concurrently with these investigations, trial EM-05 was conducted in February 2005 at the South Florida Test Facility (SFTF). The test was sponsored by PMS450C2 and involved SSN 774 for the purpose of conducting electromagnetic (EM) silencing investigations. Test planning and execution, coordination and direction of efforts in test plan development, logistics planning, personnel allocation, and trial execution, EM data acquisition, and tracking acquisition and analysis were all provided by the Signatures, Silencing Systems, and Susceptibility Core Equity. This was a one-day measurement of opportunity that was conducted to investigate potential EM-related phenomena observed during BRAVO trials. Lessons learned will be applied during the scheduled *Virginia* post-PSA EM trial.

Target strength analysis and signature control technologies, key areas of the Signatures, Silencing Systems, and Susceptibility Core Equity, have evolved since the early 1970s. Starting with the analysis of measured data from large-scale physical models of fleet submarines at Lake Pend Oreille in Idaho, the program has progressed to include theoretical analysis of scattering physics, measurement of full-scale submarines, and the development of a predictive modeling tool—known as the Target Strength Predictive Model (TSPM). The TSPM allows submarine designers to investigate the effects of changing size, shape, and materials of structural features to achieve target strength reduction in a cost-effective way. The most recent examples of the use of the TSPM include design of signature control technologies for the *Seawolf* and *Virginia* Class submarines. For the first time the TSPM is being used to verify that the *Virginia* Class meets key target strength performance parameters in lieu of performing a full-scale trial. This approach saves the *Virginia* Program Office about $15 million in equipment and trial costs.

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TECHNOLOGY & INNOVATION

ENCAPSULATED PROPELLERS

Innovative Approach May Help Create Savings

By William Palmer

In 1997, researchers perfected a way to encapsulate submarine propulsors within a polyurea coating, using molding and bonding procedures to duplicate exacting tolerances without machining or hand finishing. Signatures, Silencing Systems, and Susceptibility and Structures and Materials Core Equities were among the initial group that researched,

Innovative Approach (Continued on page 20)

A propeller blade during encapsulation process. Black fringe is mold used to form the shape of the encapsulation.
Photo by Paul Coffin, Carderock Division

Innovative Approach (Continued from page 19)

tested, and perfected the encapsulation process. The process worked well and sponsors required rigorous testing prior to use on U.S. submarines. The latest iteration of this testing is the installation of encapsulated propellers on a 110-foot yard patrol craft (YP 677) stationed at the Annapolis Naval Station.

Current encapsulation practices established by this research group use a structural "core" with dimensions loose enough for fast and inexpensive production. The core is processed to ensure bonding and then placed in a mold. The space between the propulsor and the mold is filled with polyurea, which, when cured, results in the outside propulsor blade dimensions conforming to design tolerances without hand finishing. The polyurea can also be easily reworked, if required, due to in-service damage. This saves manufacturing time and cost because the polyurea surface does not require precision machining. The precise hydrodynamic contour is molded in the coating. A second cost-saving and performance possibility this coating offers is that the traditional alloys used in propulsor components, which are exposed long-term to sea water, could conceivably be replaced with a higher strength, ferrous-based "core," which would reduce the cost of manufacturing the propulsor and offer increased performance, among other advantages.

Impact damage to the coating was a major question during development. Researchers determined that impact damage resulted in less deformation than nickel aluminum bronze and that, in the case of severe impact, the encapsulation would remain in place despite removal of material from the leading edge, which would expose the core. Encapsulated propeller components were successfully installed on submarines as "skegs," or projections, welded to the submarine hull, and also on New York City harbor tugboats. Even though a propeller blade sheared completely off the propeller hub during wintertime ice-breaking operations, the encapsulated test samples welded to the rudder frame stayed in place.

The current demonstration of two encapsulated YP propellers consists of both American Bureau of Shipping-approved stainless steel and bronze base blades. These propellers were constructed several years ago and are now being used as a part of a Naval Academy Trident Scholars project. A Naval Academy student scholar spent the summer of 2004 learning propeller design, analysis, and testing techniques, and prepared a report based on comparison of standard metal propellers to encapsulated and carbon fiber propellers designed and built by the student. Personnel from the Structures and Materials Core Equity assisted through direct instruction to the student, as well as assistance in propeller design techniques, developing an appropriate test plan, and collecting test data.

Port encapsulated propeller on YP 677. Installation is latest in series of real-world demonstrations of encapsulated propulsor performance. *Photo by Ensign Christopher Wozniak*

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TECHNOLOGY & INNOVATION

LOGISTICS MADE EASIER

Advancing the Delivery Systems for "Navy After Next"

By Chris Hatch

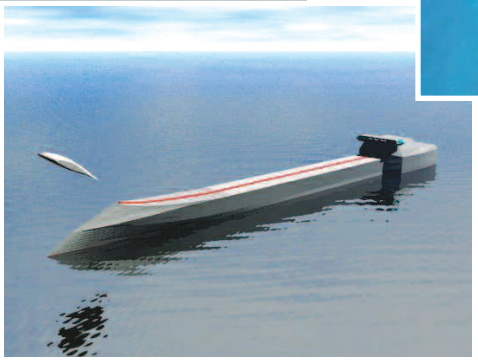
Marine units are conducting operations in a hostile zone. Supplies are running low—the call goes out for resupply. Fifty miles away a ship points its bow towards shore and begins firing projectiles. Rather than ordnance, this ship is launching supply drones—unmanned gliders—filled with between 600 to 1,600 pounds of supplies, such as batteries, food, medicine, and other vital material.

The Advanced Logistics Delivery System (ALDS) could be the future of cargo delivery in hostile areas, says Patrick McGinnis, ALDS Launch Concepts Project Management Team leader. "ALDS would provide increased flexibility and pinpoint delivery of critical logistics and supplies to deployed troops. The system could deploy from a sea base and deliver a non-stop stream of supply drones for two days straight to a drop zone under friendly control."

In hostile environments, supplying deployed units with necessary equipment can be tricky at best. Resupply efforts—often consisting of air drops and limited in scale—depend on land bases and place more personnel

Advanced Delivery Systems (Continued on page 22)

Artist concept of the Advanced Logistics Delivery System (ALDS)
Carderock Division



Artist concept of an ALDS drone launch.
Carderock Division

Artist concept of a drone in the glider configuration with wings deployed after launch.
Carderock Division

Advanced Delivery Systems (Continued from page 21)

in potential danger. ALDS would provide critical supplies more efficiently and remove personnel from unnecessary harm.

The ALDS concept was initially developed in the Naval Surface Warfare Center Carderock Division Innovation Center in 2002. Subsequently, the Office of Naval Research (ONR) tasked the NAVSEA/ONR Center for Innovation in Ship Design (CISD) to develop innovative Seabasing concepts. ALDS was further developed with team members from private industry and experts in power and energy storage, structural and mechanical dynamics, and linear motor design from Carderock Division.

This sort of teamwork is becoming more and more common within military design circles, according to CISD's Colen Kennell. "Most of the people involved had never worked together before. They came together and in three months had a very workable design," says Kennell. "Fostering this kind of collaboration is paying dividends."

The idea for ALDS was to apply existing and future technologies to this forward thinking concept. Accordingly, it could be at least 20 years or more before a functioning ship could be deployed, but advanced development of the concept allows Navy leaders to plan for the future.

Early design plans for ALDS portray a futuristic looking vessel—part cargo ship, part aircraft carrier, and part manufacturing plant. The most striking feature, aside from its tri-hull design, is the launch tube for the supply drones, which projects 10 feet from the ship's deck—almost like a circus cannon.

The ship and its mission, however, are no laughing matter. As an integral part of "Future Navy's" Seabasing concept, ALDS is a vital link to deployed units. The ship is designed to be a completely self-contained unit. Packing supplies and even the construction of drones from raw materials would all be performed aboard ship. Designers envision single-use drones launched from the bowels of the ship using electro-magnetic catapult technology, similar to that used on the Navy's next generation of aircraft carrier.

"You have to imagine a Mini Cooper traveling down a football field and being airborne in one second," says McGinnis. "Down range, our forces would cordon off an area where the drones would make a controlled crash landing. Once the deliveries have stopped, the troops move in and pick up the supplies … you definitely wouldn't want to be in the area when the supplies are coming in."

As impressive as the ALDS is, it is far from finished. Students from Virginia Tech are tackling the system from a fresh perspective and, according to Kennell, have come up with some different concepts from the initial designs. Potentially, these new designs could be melded with the existing concept, or replace aspects of it altogether.

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TECHNOLOGY & INNOVATION

MULTI-AGENCY CRAFT CONFERENCE

Warfare Center and Old Dominion University Team Up to Host 8th Annual Event

By Kristina Smith Bowab

The Warfare Center's 8th annual Multi-Agency Craft Conference (MACC) was held at Old Dominion University's (ODU) Frank Batten College of Engineering and Technology May 16 through 20 in Norfolk, VA. The Ships and Ship Systems (S^3) Product Area co-hosted the event with the Littoral Warfare Systems, Homeland and Force Protection, and Ordnance Product Areas also participating.

With more than 1,000 participants representing 17 different countries, MACC 2005 once again successfully provided a forum for open exchange and discussion about boats and craft among the military, government, and commercial agencies in the maritime community. This year's theme was "Technological Innovations/ Tactical Applications."

MACC 2005 was sponsored by the Naval Sea Systems Command Program Executive Office Ships, PMS 325, the U.S. Special Operations Command, Program Executive Office Maritime, and the Marine Corps Supply Command. The conference's primary focus is to promote dialogue on common issues unique to boats and craft in their service.

In the current and future global warfare theater, force protection, littoral warfare, and limited conflict missions place vital emphasis on stealthier, more capable craft. MACC 2005 examined emerging technology that is shaping combatant craft of the 21st century and explored innovations currently used in newly developed boats and craft.

MACC 2005 included two days of keynote speakers, technical presentations, exhibit booths, and static craft displays. Dr. Roseann Runte, ODU President; Bilyana Anderson, Deputy Program Manager, PMS 325; and Scott Littlefield, P.E., Director ONR/PEO Ships made keynote addresses. Members of the DoD craft

MACC Conference (Continued on page 24)

This Homeland Security boat was one of many in-water demonstrations for MACC attendees.
Photo by Dolly Drab, Carderock Division

First floor exhibit area in Old Dominion University's Constant Convocation Center.
Photo by Dolly Drab, Carderock Division

MACC Conference (Continued from page 23)

community and industry supplied the conference with more than 40 boats for static displays and in-water demonstrations.

Plans are in the works for MACC 2006, tentatively scheduled for June 2006. For information on next year's MACC, visit http:www.boats.dt.navy.mil/macc.html or contact Judy Tukey at 757-462-4114 (DSN 253).

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TECHNOLOGY & INNOVATION

CALL FOR PAPERS

Ships and Ship Systems Technology Symposium
*Looking for **Technical Papers** on "Changes, Challenges, and Constants"*

By David Byers

The Ships and Ship Systems (S^3) Technology Symposium is being held September 19 through 20, 2006, at the Maritime Technology Information Center, West Bethesda, MD. This is a national forum sponsored by ASNE and supported jointly by NSWC Carderock Division and the NAVSEA S^3 Product Area Director.

The symposium committee is seeking technical papers. The theme is "Changes, Challenges, and Constants." Abstracts are due not later than October 31, 2005. For more information about submissions and the symposium, please contact the following S^3 Technology Symposium Program Committee member:

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Ship Integration & Design

This core equity applies specialized expertise for surface and undersea vehicle design including early concept development, assessment and selection of emerging technologies, integration of selected technologies into optimized total vehicle designs, and evaluation of those technologies and designs for cost, producibility, supportability, and military effectiveness.

Machinery Systems

This core equity provides full-spectrum technical capabilities (facilities and expertise) for research, development, design, shipboard and land-based test and evaluation, acquisition support, in-service engineering, fleet engineering, integrated logistic support and concepts, and overall life-cycle engineering.

Hull Forms & Propulsors

This core equity provides the Navy with full-spectrum hydrodynamic capabilities (facilities and expertise) for research, development, design, analysis, testing, evaluation, acquisition support, and in-service engineering in the area of hull forms and propulsors for the U.U.S. Navy.

Vulnerability & Survivability Systems

This core equity provides full-spectrum capabilities (facilities and expertise) for research, development, design, testing, acquisition support, and in-service engineering to reduce vulnerability and improve survivability of naval platforms and personnel.

Environmental Quality Systems

This core equity provides facilities and expertise for research, development, design, human systems integration, acquisition support, in-service engineering, fleet support, integrated logistic concepts, and life-cycle management resulting in mission compatible, efficient and cost-effective environmental materials, processes, and systems for fleet and shore activities.

Signatures, Silencing Systems, & Susceptibility

This core equity specializes in research, development, design, testing, acquisition support, fleet guidance and training, and in-service engineering for signatures on ships and ship systems for all current and future Navy ships and seaborne vehicles and their component systems and assigned personnel.

Structures & Materials

This core equity provides the Navy with specialized facilities and expertise for the full-spectrum of research, development, design, testing, acquisition support, and in-service engineering in the area of materials and structures.

SEAFRAME

Ships & Ship Systems Quarterly Publication

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